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ON THE OCCURRENCE OF THE TRILOBITE GENERA *ACASTE* AND *ACASTELLA* IN VICTORIA

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Abstract

Acaste longisulcata sp. nov. and *Acastella frontosa* sp. nov. are described from the Ruddock Siltstone of the Lilydale district of Victoria. These species are the first undoubted representatives of their genera to be recorded from the southern hemisphere. The species of *Acaste* becomes the youngest (in the stratigraphical sense) yet reported. It is compared in general terms to *Acaste dayiana* Richter & Richter 1954 while *Acastella frontosa* is compared in similar terms to *A. patula* Hollard 1963 and *A. rouaulti* (de Tromelin & Lebesconte 1875). The age of the Victorian species is Lower Devonian. In terms of north-west European stratigraphy they occur within the time span, high Lower Gedinnian to Siegenian.

Introduction

Apart from the reference by Gill (1940, p. 241, 253) to *Phacops* (*Acastina*) the genera *Acaste* and *Acastella* have not previously been reported from Australia, though the species described below were actually noted and figured by Chapman (1915, p. 168-9, Pl. XV, fig. 14, 15) under the nomen *Phacops crossleii* Etheridge fil. and Mitchell. The genera exist contemporaneously in beds of Lower Devonian age in the Lilydale district of Victoria.

The occurrence of *Acaste longisulcata* sp. nov. in beds of this age is of interest from the point of view of both spatial and temporal distribution, for the species becomes the stratigraphically youngest attributed to the genus and is the first true *Acaste* to be recorded from the southern hemisphere. Though species of the genus have been reported from South America, the actual occurrence may be doubted. Of the species in question *Acaste lombardi* Kozlowski 1913 (Ponta Grossa Shales, Paraná, Brazil), *A. verneuili* (d'Orbigny 1842) (Icla Formation, Sieasica Formation, Bolivia), *A. perplana* Knod 1908 (*Conularia* and *Lingula* Sandstones, Jachal, Argentina), and *A. cordobesa* Méndez-Alzola 1938 (lateral equivalents of the Ponta Grossa Shales, Rincón de Alonso, Arroyo del Cordobés, Uruguay) are most certainly better referred to the genus *Acastoides* Delo 1935, while *Acaste convexa* (Ulrich 1892) has many features comparable to *Calmonia subseciva* Clarke 1913.

Acastella frontosa sp. nov. also represents the first undoubted record of the genus from the southern hemisphere. Reed (1925) described the species *Dalmanites* (*Acastella*) *pseudoconvexus* from the Bokkeveld Beds of South Africa but his illustration of the cephalon (Pl. 9, fig. 8) is too poor to permit critical interpretation in the light of recent work in Europe (Richter & Richter 1954, Pillet 1959, 1961, Tomczykowa 1962, Hollard 1963, Shergold 1967).

In the following text, specimens from the National Museum of Victoria are labelled VNM, those from the Geological Survey of Victoria, GSV, and those from the Geological Survey Museum, London, GSM.

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Symbols utilized for parameters, and proportions quoted in the descriptions are basically those of Struve (1958, p. 167). They are defined as follows: A, exsagittal length of eye; H, distance between the back of the eye and the posterior border furrow; G, sagittal glabellar length; Gn, sagittal glabellar length plus the sagittal dimension of the occipital ring H:A; A:G (large eye index); A:Gn (small eye index).

Systematic Descriptions

Family Dalmanitidae Vogdes 1890

Subfamily Acastinae Delo 1935

Genus **Acaste** Goldfuss 1843

Acaste longisulcata sp. nov.

(Pl. 4, fig. 7-8; Pl. 5, fig. 1-12)

1915 *Phacops crossleii*, Etheridge fil & Mitchell (pars.); Chapman 1915, p. 168-9, Pl. XV, fig. 15 (VNM P12680, pygidium).

1940 *Phacops* (*Acastina*), sp. nov. (?); Gill 1940, p. 251, 253.

Derivation of Name: A species of *Acaste* with all three pairs of lateral glabellar side furrows reaching further towards the sagittal line than in any other known species; hence long furrows latinized—*longisulcata*.

Type: Holotype (here designated); the complete pygidial internal mould, VNM P12680, figured by Chapman (1915, Pl. XV, fig. 15), refigured here Pl. 4, fig. 7-8.

Locality and Horizon of Type: Ruddock's Quarry, approximately 1¾ miles NW. of Lilydale railway station, Lilydale, Victoria; Gill locality 20 (Gill 1940, p. 252, Fig. 1).

Ruddock Siltstone, Yering Group (sens Gill 1965, p. 119), Lower Devonian (possibly Siegenian, see below).

Material and Occurrence: *Acaste longisulcata* sp. nov. occurs in the Ruddock Siltstone of the Lilydale area, Victoria. In these beds the type specimen, which Chapman (1915, Pl. XV, fig. 15) considered to represent the pygidium of *Phacops crossleii* Etheridge & Mitchell, was obtained from Ruddock's Quarry (Gill 1940, Fig. 1, locality 20). It is a large but complete internal mould which has suffered slight lateral distortion, and is undoubtedly a late holaspid individual. Its length (sag.), from the transverse furrow, separating the articulating half ring from the first axial ring, to the posterior margin, measures 8·80 mm. The axial length (sag.) is 7·60 mm, the axis thus occupying 86% of the total length. The maximum width (tr.) of the pygidium amounts to 15·65 mm, while that of the axis at the first ring measures 4·85 mm. Anteriorly the axis thus occupies 31% of the total pygidial width.

A considerable amount of supplementary material has been collected recently by Mr E. D. Gill, consisting of numerous disarticulated cephala and pygidia. While the general condition of preservation is good, all the specimens available are to some degree distorted by lateral or oblique compression. These specimens are all considerably smaller than the type and represent in the main early holaspid morphogenetic stages. The additional material was collected from a quarry on the north side of the Maroondah Highway, W. of Black Springs, Lilydale (this being Gill's locality 50, unpublished). Gill (1940, p. 251) also referred to *Phacops*

(*Acastina*) from a cutting on the main Melbourne-Lilydale road between North Croydon and Black Springs (Gill 1940, locality 18). Reference to Gill's Fig. (op. cit.) shows that all the localities mentioned above lie within the same general area and indeed are within ½ mile of each other.

To the species *Phacops crossleii* Eth. & Mitch. sens Chapman (1915, p. 168-9) (=*Acaste longisulcata* sp. nov.) Chapman also referred specimens from Kinglake West and from a branch of the Saltwater River, one mile W. of Gisborne. These specimens, respectively VNM P12682 and P1218, have been re-examined and are considered not referable to *Acaste*.

The cranidium figured by Talent (1964, p. 57, Pl. 27, fig. 7) as 'Dalmanitidae gen. indet. *C*' from the Mt Ida Formation of the Heathcote district of Victoria does, however, represent a species of *Acaste*. Further cranidia were collected on the 1967 ANZAAS excursion to this area by Dr J. A. Talent. As yet the author has examined only a limited number of specimens, rather indifferently preserved, and hesitates to compare too closely this material with the species under consideration.

Diagnosis: A species of *Acaste* Goldfuss 1843 having, in the undistorted condition, a markedly triangular cephalic outline as in *Acaste dayiana* Richter & Richter 1954; proportionately narrow (tr.) glabella; long glabellar furrows extending inwards to within a very short distance of the sagittal line; pygidium with strong convexity (tr.), 8 axial rings, 5-6 pleural segments; lacking a marked marginal furrow on both shell and internal mould.

Description: Cephalic outline triangular to subtriangular; cephalic surface very finely granulose.

Glabella proportionately long (sag.) and narrow (tr.), with greatest width (tr.) across the frontal lobe; tapering evenly to the posterior, the confining axial furrows diverging forwards at approximately 16 degrees; anteriorly and antero-laterally broadly rounded; in lateral profile with low to moderate convexity (sag.) across the frontal lobe, flat across the side lobes. Anterior lateral glabellar lobes distinctly subtriangular in small specimens, more nearly subrectangular in larger ones; median lateral glabellar lobes subrectangular, posteriorly curved; preoccipital lobes narrow (exsag.), about ⅔ as wide (exsag.) as the preceding lobes, with slightly greater convexity (tr.).

Anterior lateral glabellar furrows strongly incised as in most other species of *Acaste*, sigmoidal, with distinct posterior median deflection; a gap is left a little less than one-fifth the width of the glabella between the adaxial ends of these furrows, which is smaller than in many other species of the genus; median lateral furrows a little more deeply incised, shorter, linear, transverse, not reaching the axial furrows laterally, adaxially slightly more distant from the sagittal line than the ends of the anterior pair of furrows; preoccipital furrows much deeper and wider (exsag.), strongly curved, with both adaxial and abaxial curvature to the anterior and a tendency for the former to converge towards the ends of the anterior lateral furrows. A short sagittal furrow runs longitudinally across the basal ¼ of the frontal lobe, commencing between the adaxial ends of the anterior pair of furrows.

Occipital furrow as deep abaxially as the preoccipital furrows, shallow mesially, widening sagittally. Occipital ring slightly wider (tr.) than the preoccipital lobes but with similar convexity (tr.); rising in lateral profile well above the level of the glabellar side lobes.

Genae evenly convex, without appreciable marginal furrow; postero-laterally acutely angled in late holaspides (Pl. 5, fig. 1-2) and minutely spined in early holaspides (Pl. 5, fig. 3, left gena), comparing closely in this respect with the development of the genal angle in *Acaste downingiae* (Murchison) (Shergold 1966, p. 189-190). Preocular section of the facial suture marginal or just dorsal intra-marginal, running concentric to the contour of the frontal glabellar lobe; postocular section cutting the lateral cephalic margins approximately opposite the middle of the preoccipital lobes.

Eyes of normal size, situated on low ocular platform, close to glabella; extending from the level of the middle of the preoccipital lobes to the confluence of the anterior lateral glabellar furrows and the axial furrows; A:Gn 39-42%; A:G 45-50%; H:A 16-25%. Palpebral lobes prominent, palpebral areas narrow (tr.). Visual surface known from a single immature specimen showing 6 lenses alternating with 7 at the maximum height of the surface.

Nature of hypostome and thorax unknown.

Pygidium with semicircular outline in all specimens, subtriangular in large specimens; with entire margin, posteriorly rounded. Axis with moderate convexity (tr.), occupying about 85-90% of the total pygidial length, terminating abruptly; composed of 7 rings in small and 8 in large specimens. Pleurae strongly convex (tr.), with 5 segments in early holaspides, 6 in late holaspides; pleural furrows rather narrow (exsag.); interpleural furrows relatively well-defined separating all segments. Border wide and without marginal flattening in small specimens, narrower with a poorly-defined furrow in large individuals.

RELATIONSHIPS: *Acaste* is an homogenous genus, species being differentiated on the basis of character complexes rather than single characteristics. Features important in distinguishing species within the genus are: the overall geometry of outline of cephalon and pygidium; relative proportions and shape of glabella; the convexities and proportions of its lobes and the relative lengths and courses of its furrows; the angle of divergence forwards of the axial furrows; the relationship between frontal lobe, preglabellar area and anterior cephalic margin; size and position of the eyes and contents of the visual surface; segmentation of the axis of the pygidium, its relative length, width and convexity; the presence or absence of a marginal furrow or flattening in the pygidium and the width of the border.

In its geometry of cephalic outline *Acaste longisulcata* sp. nov. approaches that of *A. dayiana* Richter & Richter 1954 and the *Acaste* sp. from South Wales figured by the Richters (1954, Pl. 3, fig. 44) and refigured here (Pl. 5, fig. 13-14) for comparison. The outline is decidedly triangular and is thus differentiated from species with more subpentangular outlines, such as *A. downingiae* (Murchison 1839) and *A. inflata* (Salter 1864). The pygidium is wider (tr.) than in most other *Acaste* species but this observation may be influenced by preservation.

In its glabellar shape and convexities the Australian species again approaches *A. dayiana. A. downingiae, A. inflata* and *A. subcaudata* (Murchison 1839). All have a wider (tr.) glabella with axial furrows diverging anteriorly at lesser angles, i.e. they are more nearly parallel-sided. *A. longisulcata* is unique in the length of its furrows. The convexity of the frontal lobe (sag.), however, recalls both *A. dayiana* and *A. inflata*, but the convexities of the lateral lobes are considerably less than in the latter species.

The narrow, triangular area of librigena which lies between the frontal lobe and the slightly angled anterior preocular section of the facial suture in *A. downingiae, A. inflata, A. subcaudata* and *A. dayiana* is much reduced in *A. longisulcata*.

The proportions establishing the size of the eyes in species of *Acaste* with respect to the glabellar lengths and distance from the posterior border furrow are listed below:

	A : G	A : Gn	H : A	Lenses at max. of vis. surf.
A. downingiae	46-67	37-54	12-30	7(8)/8(9)
A. inflata	47-56	40-48	5-18	6/7
A. subcaudata	45-63	37-46	12-27	5/6
A. longisulcata	45-50	39-42	16-25	6/7
A. dayiana	Not obtained			5/6

The eyes of *A. longisulcata* are perhaps closer to the glabella than in many species of the genus but appear to be situated with reference to the posterior border furrow in a comparable position. In the content of the visual surface *A. longisulcata* is comparable to *A. inflata*. There are fewer lenses than in *A. downingiae* but more than in *A. dayiana* and *A. subcaudata*.

As in *A. downingiae* the early holaspid pygidial borders are non-furrowed. In *A. subcaudata* moulds of comparable size show a marginal furrow. In *A. dayiana* a furrow is developed on the mould but the shell is non-furrowed. The overall pygidial segmentation, with 5-6 pleural segments and 7-8 axial rings, is comparable to that of *A. inflata* and *A. subcaudata*. *A. downingiae, A. dayiana* and *A. talebensis* Hollard 1963 have extra rings in the axis, 7-9, 7-10 and 8 respectively and there may also be an additional pleural segment.

Several of the observed differences between *A. longisulcata* and other species may be influenced by the fact that a full range of specimens covering the total size span of the species is not available. Further, some species are known largely from moulds, others largely from specimens preserved with the shell. Detailed morphogenetic changes within the species cannot therefore be elucidated at the time of writing. Nevertheless *A. longisulcata* does, during morphogenesis, show similar trends to the changes occurring in the type species, *A. downingiae*, the only species known in considerable detail (Shergold 1966). In common with that species, with *A. subcaudata* and possibly also other species of the genus, *A. longisulcata* possesses mucronate genae in the earliest holaspid morphogenetic stages. The genae of late holaspides are likewise acutely angled or rounded off. Similarly there is a general increase during the holaspid morphogenesis in the degree of segmentation of the pygidium.

Genus **Acastella** Reed 1925

Acastella frontosa sp. nov.

(Pl. 3, fig. 1-4; Pl. 4, fig. 1-6)

1915 *Phacops crossleii*, Etheridge fil & Mitchell (pars.); Chapman 1915, p. 168-9, Pl. XV, fig. 14 (VNM P12679, nearly complete individual).

Derivation of Name: L. *Frontosa*, describing the anterior cranidial process which lies between the frontal glabellar lobe and the preocular section of the facial suture.

Type: Holotype (here designated); the nearly complete internal mould of a large individual figured by Chapman (1915, Pl. XV, fig. 14), refigured here Pl. 3, fig. 1-3, VNM P12679.

Locality and Horizon of Type: Ruddock's Quarry, approximately 1¾ miles NW. of Lilydale railway station, Lilydale, Victoria.

Ruddock Siltstone, Yering Group, Lower Devonian (possibly Siegenian).

Material and Occurrence: The holotype is very nearly complete but somewhat distorted; the left gena has exaggerated convexity and has lost the palpebral lobes and the visual surface; the caudal mucronation of the pygidium is not preserved and the axial region has been lost; genal mucronations have also been eroded away.

Several other examples of this species have been located. A second nearly complete individual from the National Museum of Victoria, VNM P26076, lacks only the posterior part of the pygidium. Of the three specimens from the collections of the Geological Survey of Victoria figured here (Pl. 3, fig. 4; Pl. 4, fig. 1-6), the cranidium, GSV 61859, and the cephalon, GSV 61860, show to advantage the genal spines and glabellar convexities but the pygidium, GSV 61861, again lacks the caudal mucronation.

Early holaspid morphology remains unknown at the time of writing, the available material representing late holaspid morphogenetic stages.

The holotype possesses the following dimensions and proportions: Length of cephalon (estimated), 14·15 mm; Length of glabella plus occipital ring, Gn, 13·75 mm; Length of glabella, G, 11·90 mm; Length of eye, A, 5·05 mm; Distance of eye from posterior border furrow, H, 1·30 mm; Width of frontal lobe, 10·05 mm; Width of preoccipital lobes (estimated), 6·00 mm; Length of thorax (estimated), 20·55 mm; Length of pygidium (estimated to spine base), 10·45 mm; Width of pygidium (estimated), 15·75 mm; the eye occupies 42·5% of the glabellar length (A : G) and 37% of the length of the glabella plus occipital ring (A : Gn); the distance between the back of the eye and the posterior border furrow (H) amounts to 25·75% of the eye length (A) (ratio H : A).

Acastella frontosa sp. nov. occurs together with *Acaste longisulcata* sp. nov. in the Ruddock Siltstone of Ruddock's Quarry, Lilydale (Gill 1940, Fig. 1, locality 20), an horizon lying some 1000-1500 ft above the base of the formation. Further specimens are figured here from 'red shales outcropping by a road cutting 14 chains from the Melbourne-Lilydale highway, ½ mile west of Lilydale', this locality being known as 'Hull Road, Lilydale' (Gill 1940, p. 257, Fig. 1, locality 1). This horizon lies considerably above that of Ruddock's Quarry. There is another specimen in the collections of the National Museum of Victoria from the locality known as 'Wilson's' on 'the old Melbourne road, near the top of the hill, about ½ mile above Lilydale' (Gill, op. cit., p. 257, locality 2). The horizon of this outcrop lies at a comparable stratigraphical level to that of 'Hull Road, Lilydale'.

Diagnosis: A species of *Acastella* Reed 1925 with a very prominent, triangular, forward extension of the anterior cranidial margin lying immediately in front of the glabella, defined by the preocular section of the facial suture produced into angles between 40-45 degrees, imparting to the cephalic outline a markedly ogival aspect; axial furrows curving outwards at the level of the median lateral glabellar lobes furrows, drawn in at the level of the preoccipital and anterior furrows; preoccipital furrows with distinct angle in their middle courses causing a constriction and distal expansion of the preoccipital lobes; pygidium with wide (exsag.), channel-like pleural furrows of dalmanitoid appearance.

Description: Cephalic outline ogival to subpentangular, anteriorly distinctly angled; cephalic surface finely granulose.

Glabella anteriorly gently angled, antero-laterally sharply angled or rounded depending on preservation; widest (tr.) across the frontal lobe, decreasing irregularly in width (tr.) to the posterior. Axial furrows defining the glabellar outline drawn in slightly at the anterior lateral and preoccipital furrows, expanding outwards at the median lateral furrows.

Frontal lobe long (sag.), with low to moderate convexity (sag.) in lateral profile; bearing on the internal mould 4 or 5 rows of tubercles, radiating across the convexity of the lobe from a point between the adaxial extremities of the anterior lateral furrows; on the cast from the external mould a short longitudinal furrow lies sagittally in this position. Anterior lateral lobes nearly as wide (tr.) as the frontal lobe, triangular, fused abaxially with the median lateral lobes; the latter are narrower (tr.) than the anterior lobes and are subrectangular, with strong posterior curvature; preoccipital lobes narrow (exsag.), ⅔ as wide (exsag.) as the median lateral lobes, with slightly greater convexity (tr.), a slight constriction in the middle section of these lobes contrasts to a distal expansion.

Anterior lateral furrows shallow, wide, opening slightly abaxially, sigmoidal in smaller specimens with marked posterior median deflection, straighter, more nearly oblique in larger specimens; median lateral furrows shorter, linear, transverse, a little shallower than the anterior furrows, without median deflection to the posterior, failing laterally to reach the axial furrows; preoccipital furrows deep and wide, strongly curved both adaxially and abaxially to the anterior, there being a marked 'elbow' at the meeting of these curvatures in the centre of the furrow. There is only a faint tendency for the adaxial convergence of the preoccipital and anterior lateral furrows.

Occipital furrow relatively wide (sag. and exsag.), slightly constricted sagittally, deep abaxially. Occipital ring slightly less wide (tr.) than the preoccipital lobes but with somewhat greater convexity (tr.); wide (sag.); in lateral profile barely rising above the level of the glabellar side lobes.

Genae subtriangular, moderately convex, without appreciable marginal furrow or flattening; posterior margin of cephalon sinuous, with stout postero-lateral spines apparently developed as a backwards extension of the lateral cephalic margins. Postocular sections of facial suture cutting lateral cephalic margins nearly opposite the level of the occipital furrow; preocular section following the lateral and antero-lateral margins of the frontal lobe but deviating from this course anteriorly, forming sagittally a markedly acute angle of 40°-45°; between the margin of the frontal lobe and the preocular facial suture a narrow band, representing the cranidial border, is retained antero-laterally, becoming anteriorly produced into a very distinct and characteristic conical projection, inclined very slightly upwards (Pl. 4, fig. 4).

Eyes subcrescentic in plan view, posteriorly close to the glabella and to the posterior border furrow; extending from the level of the posterior edge of the preoccipital lobes to the confluence of the anterior lateral furrows and the axial furrows or from the preoccipital furrows to a position slightly in front of that confluence; in anterior profile rising to the level of the top of the glabella surface. Visual surface with 7 or 8 lenses at its maximum vertical height. Palpebral lobes prominent, somewhat wider posteriorly; palpebral furrows well-defined, tightly curved; palpebral areas posteriorly narrow. Proportions indicating the size and position of the eyes cannot be given accurately from the small number of specimens known but the following variation is suggested from those measured: A:G, 35-49%; A:Gn, 43-58%; H:A, 15-26%.

Nature of hypostome unknown.

The thorax is known only from the internal mould of the holotype. Nevertheless as the thorax is imperfectly known in species of *Acastella* this single specimen warrants considerable attention. It is composed of 10 segments and in its general appearance is strongly reminiscent of the thorax of *Acaste* species. The axis, occupying a little greater than one-third the total width (tr.), is widest (tr.) at the 4th and 5th rings. Transverse furrows are wide and shallow, defined on either side of the sagittal line by deep, ovoid, apodemal pits. The rings themselves are distally expanded (Pl. 3, fig. 1, 2), similar to the preoccipital glabellar lobes. Pleural segments are divided by deep pleural furrows, commencing near the apodemal pits and cutting obliquely at first, thence flattening out to follow the anterior margin of each pleuron; distally somewhat curved and reaching nearly to the distal margin. Propleuron relatively narrow proximal to the axial furrows, wider distally with smooth antero-lateral articulating facet. Opisthopleuron approximately blade-shaped, its posterior margin curving distally backwards, then forwards culminating in a short point, much the same as the outline of the posterior cephalic border. The pleural furrows extend distally to the bases of the pleural points.

Pygidium broadly subtriangular in outline, rather strongly vaulted (tr.). Axis strongly convex (tr.), evenly tapering to the posterior, extending nearly to the posterior margin; possibly 8 rings plus a terminal piece. There are 6 pleural segments, divided by wide (exsag.), channel-like pleural furrows which extend nearly to the margins. Interpleural furrows considerably weaker but remaining well-defined, especially adjacent to the axial furrows. Border very narrow with irregular swellings, discernible in certain conditions of lighting. Margin entire; caudal mucronation not preserved on the available material.

Variation: The available specimens, while being compatible in the majority of characteristics, do show some variation in the size of the eye. The single specimen from the horizon of Ruddock's Quarry has distinctly smaller eyes than the specimens from Hull Road, Lilydale. With the small number of specimens presently available it is not possible to say that this variation lies outside that which can be normally expected in an acastinid species. In some acastomorph genera, e.g. *Acastocephala*, there is a measurable increase in the size of the eyes during holaspid morphogenesis (Shergold 1966).

Relationships: Species of *Acastella* may be divided on pygidial characteristics into two distinct groupings, these being based on the presence or absence of marginal denticles on the late holaspid internal moulds. It is only the late holaspides which can be differentiated in this manner, however, as it is suspected that a denticulate condition is exhibited in the early holaspid morphogenetic stages of most species of the genus. Three species have denticulate late holaspid moulds: *A. tiro* (Richter & Richter 1954), *A. elsana* (Richter & Richter 1954) and *A. rouaulti* (de Tromelin & Lebesconte 1875) and these are accordingly readily differentiated from *A. frontosa* sp. nov. Species with non-denticulate pygidial margins are more numerous and it is with these that the Australian species is allied. They include the type species *A. spinosa* (Salter 1864), *A. prima* Tomczykowa 1962, *A. heberti* (Gosselet 1888), *A. patula* Hollard 1963, *A. granulosa* Hollard 1963 and *A. jacquemonti* Hollard 1963.

A. frontosa is distinguished from most of these species in its glabellar outline, expanding outwards instead of drawn in at the median lateral glabellar furrows, and in its possession of a prominent frontal process. This latter peculiarity is perhaps the most interesting feature of *A. frontosa*. No other species of *Acastella* exhibits the characteristic exaggerated to the same degree, although both *A. rouaulti* and *A. patula* have a distinct angulation of the preocular facial suture anterior to the glabella (Pillet 1959, p. 940, Fig. 1; Hollard 1963, Pl. 2, fig. 1, Pl. 3, fig. 17). In both species a narrow cranidial border is formed antero-laterally to the frontal lobe, as in our species. It is in other related genera, however, that the peculiar diagnostic feature of *A. frontosa* is developed to a comparable extent. Compatible structures are present in the specimen figured by Hollard (1963, Fig. 9) as *? 'Asteropyge'* sp. *M* Richter & Richter 1954. They are also present in *Cryphaeoides rostratus* (Kozlowski 1923), *Schizostylus brevicaudatus* (Kozlowski 1923) and *Dalmaniturus weberi* Chernysheva 1937 (p. 14, Fig. 3). In *Calmonia signifer* Clarke (1913, Pl. 6, fig. 1, 3, 4) an apparently similar structure is developed from the librigena anterior to the preocular facial suture and in the genus *Paracalmonia* a true spine is present in this position (Clarke 1913, Pl. 7, fig. 11-13, 16, 19). The anterior cranidial process obviously develops initially from the condition shown by *Acastella tiro* (Richter & Richter 1954, Pl. 5, fig. 73d) in which a small deltoid area, encompassed within a distinctly angled facial suture, lies within the normal cephalic margins.

The deep and wide pleural furrows of *A. frontosa* are dalmanitoid in appearance. Among species of *Acastella* only *A. patula* (Hollard (1963, Pl. 2, fig. 2, 3 and Fig. 2c) has similar furrows but they may also be compared with those of *Treveropyge ebbae* (Richter & Richter 1954, Pl. 6, fig. 91). Though a caudal spine is preserved in none of the available specimens the general shape of the postero-lateral pygidial margins suggests that this would not have been large, probably of comparable size to that of *A. patula* Hollard (1963, Fig. 2c), *A. jacquemonti jacquemonti* Hollard (op. cit., Fig. 4b) or *A. j. levis* Hollard (op. cit., Fig. 6a).

A Comment on the Age of *Acaste longisulcata* and *Acastella frontosa*

Species of *Acaste* and *Acastella* occur most frequently in NW. Europe and N. Africa. In these areas the range of *Acaste* extends from the Middle Silurian, Upper Wenlockian (Wenlock Limestone) of the British Isles—*A. downingiae* and *A. inflata* (Shergold 1966)—to the Lower Devonian, mid-Lower Gedinnian (Upper Oudai Hara Formation) of SW. Morocco—*A. talebensis* (Hollard 1963). The genus *Acastella* ranges from the Upper Silurian, Ludlovian (Upper Leintwardine Beds of Holland, Lawson & Walmsley 1963) of the British Isles—*A. spinosa* (Shergold 1967)—and Siedlce Beds of northern Poland—*A. prima* (Tomczykowa 1962)—into the Lower Devonian, Siegenian (Grès à *Dalmanella monnieri*), Massif armoricain, Central France (Pillet 1959)—*A. rouaulti*—and beds of comparable age, Talmadert Formation, in south-west Morocco (Hollard 1963). In the Rzepin Beds (Podlasian) of southern Poland and in the Upper Oudai Hara Formation (Lower Gedinnian) of south-west Morocco species of *Acaste* and *Acastella* co-exist. A similar situation is observed in the Ruddock Siltstone of Victoria.

The Ruddock Siltstone Formation of the Lilydale area, 8000 ft thick (Gill 1965, p. 119), is succeeded by the Lilydale Limestone and Cave Hill Conglomerate Formations. The three formations together constitute the Yering Group as defined by Gill (1965). The Lilydale Limestone has become generally regarded as of late Lower Devonian age on the basis of its coral and stromatoporoid faunas (Hill 1939, Ripper 1938). Talent (1965) has suggested an Emsian age for this deposit. There is no direct indication as to the absolute time range of the Ruddock Siltstone and the formation may span a considerable interval.

Gill (1945, p. 145-6; 1965, p. 120) has recognized two successive brachiopod faunas within the Yering Group. An association of *Chonetes ruddockensis, Notanoplia australis, Plectodonta bipartita* and *Howellella* sp. apparently characterizes the lower part of the Ruddock Siltstone. The remainder of the Yering Group carries the association of *Chonetes cresswelli, C. robustus, C. micrus, Acrospirifer lily-*

dalensis and *Megakozlowskiella cooperi*. Gill (1945, p. 146) gives Ruddock's Quarry as the type locality for the lowest Yering Group fauna. Our species of *Acaste* and *Acastella* occurring together at that locality are therefore a part of that fauna. In terms of the NW. European stages Gill (1965, p. 121) has assessed the faunas of the Yering Group as a whole as comparable to those of the Gedinnian and Siegenian.

At an horizon slightly lower than that containing the 'Ruddock's Quarry fauna' Gill (1965, p. 120) has recorded the occurrence of *Styliolina fissurella* and *Nowakia matlockiensis* (= *arcuaria* ?). The presence of these elements has led Talent (1965, p. 183, Fig. 2) to correlate the lower Ruddock Siltstone with the Tanjil Formation of Central Victoria. On the basis of the tentaculitoid faunas, correlation has been further effected with strata falling within the graptolite zone of *Monograptus hercynicus* Jaeger (Lochkovian, e γ) in Bohemia. The formations thus related are quoted by Talent (1965, p. 183) as being no older than the Upper Gedinnian and most probably of Siegenian age. Jaeger (1966) in describing a new graptolite species, *M. thomasi*, from the Wilson's Creek Shales of Central Victoria, has discussed the age and correlation of these beds and the immediately overlying Tanjil Formation. His conclusions (1966, p. 397, Fig. 1) are essentially support for the ideas of Talent, i.e. that the Tanjil Formation is of probable Siegenian age. In this event the Ruddock's Quarry fauna becomes of similar age. No graptolites have yet been reported from the Ruddock Siltstone so that direct correlation on these grounds cannot be made with either the Wilson's Creek Shales or the Tanjil Formation. Correlation is effected solely with the aid of the tentaculitids.

In assessing the relationships of *Acaste longisulcata* sp. nov., comparison is indicated with *A. dayiana*, a species from the Lower Devonian (Shirley 1962) Köbbinghäuser Schichten of the German Rhineland, which beds are possibly of lowest Lower Gedinnian age. The Australian species of *Acastella*, existing contemporaneously with *Acaste longisulcata* in Victoria, has certain affinity to *Acastella patula*, from the Lower Oudai Hara Formation of SW. Morocco, of definite Lower Gedinnian age, and *A. rouaulti* which occurs in beds of Siegenian age. *A. frontosa* may be classified with the non-denticulate species-group of *Acastella* which ranges, in the northern hemisphere, to the top of the Lower Gedinnian (Sidi M-Bark Formation) in Morocco. The denticulate species-group extends a little higher, into the Siegenian. The absence of the denticulate forms of *Acastella* coupled with the presence of *Acaste* indicates that the Ruddock Siltstone at Ruddock's Quarry is older than the Siegenian, being probably of late Gedinnian age, though the remainder of the formation may range into the Siegenian. The absence of the *Acaste* at Wilson's and the Hull Road locality, horizons at stratigraphical levels above that at Ruddock's Quarry, may underline this point.

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Explanation of Plates

Plate 3

Acastella frontosa, fig. 1-4

Fig. 1-3—VNM P12679: holotype, internal mould dorsal exoskeleton, figured Chapman 1915, Pl. XV, fig. 14; fig. 1, dorsal view, × 4; fig. 2, lateral view, × 4; fig. 3, dorsal view pygidium showing widened pleural furrows, × 4. Ruddock's Quarry, Lilydale.

Fig. 4—GSV 61859: latex cast from external mould of cranidium, dorsal view, × 4. Hull Road, Lilydale.

Plate 4

Acastella frontosa, fig. 1-6
Acaste longisulcata, fig. 7-8

Fig. 1-2—GSV 61859: internal mould of cranidium; fig. 1, dorsal view, × 4, showing anterior cranidial process; fig. 2, lateral view, × 4, showing genal spine. Hull Road, Lilydale.

Fig. 3-4—GSV 61860: latex cast from external mould of cephalon; fig. 3, dorsal view, × 4, showing well-defined anterior angulation of the frontal lobe and the anterior cranidial proeess; fig. 4, lateral view, × 4, showing the genal spine and upturned frontal process. Hull Road, Lilydale.

Fig. 5-6—GSV 61861: internal mould pygidium; fig. 5, dorsal view, × 6, showing entire margins; fig. 6, posterior view, × 6, showing convexity. Hull Road, Lilydale.

Fig. 7-8—VNM P12680: holotype of *Acaste longisulcata*, internal mould pygidium, figured Chapman 1915, Pl. XV, fig. 15; fig. 7, dorsal view, × 4; fig. 8, posterior view, × 4. Ruddock's Quarry, Lilydale.

Plate 5

Acaste longisulcata, fig. 1-12, all material from west of Black Springs, Lilydale.
Acaste sp. fig. 13-14, Golden Grove, Llandeilo, Caermarthenshire, South Wales.

Fig. 1-2—VNM P25230: two aspects of a well preserved cephalon; fig. 1, internal mould showing angled left gena, × 4; fig. 2, latex cast from the external mould, × 4.

Fig. 3—VNM P25233: internal mould cephalon, early holaspid showing left genal spinule, × 6.

Fig. 4—VNM P25240: internal mould ineomplete cephalon, distorted, × 4.

Fig. 5—VNM P25231: internal mould cephalon, × 4.

Fig. 6-7—VNM P25234: internal mould incomplete eephalon; fig. 6, dorsal view, × 4; fig. 7, lateral view showing visual surface, × 4·5.

Fig. 8—VNM P25232: internal mould distorted cephalon, × 5.

Fig. 9—VNM P25235: internal mould pygidium, × 6.

Fig. 10—VNM P25236: latex cast from external counterpart of fig. 9, × 6.

Fig. 11—VNM P25238: internal mould pygidium, × 6.

Fig. 12—VNM P25237: latex cast from an external mould, × 6.

Fig. 13-14—GSM 19403: internal mould cephalon, figured Riehter & Richter 1954, Pl. 3, fig. 44, ineluded for comparison; fig. 13, dorsal view, × 4, fig. 14, lateral view, × 4.